Forest Pest
Management

200 Weaver Boulevard
Asheville, NC 28804

3400

Jan. 31. 1984

#84-1-3

Sylvester Putman, Supt.
National Park Service
Richmond National Battlefield Park
3215 East Broad St.
Richmond, VA 23223

Dear Mr. Putman:

During the week of December 19, I met with Chuck Rafkind to discuss two aspects of resource management at Richmond National Battlefield Park. First, we examined several wood structures in the park and discussed their protection from wood destroying insects and fungi. Second, we discussed the identification and control of hazardous trees and spent approximately 1-1/2 days identifying hazardous trees in the park.

This report will be in two parts, with each subject covered separately.

PROTECTION OF WOOD STRUCTURES

Maggie Walker House

This structure is in excellent condition at the present time. I inspected the main basement room, but did not inspect the crawl space on the west side or the HVA tunnel. The main furnace room does not have current insect or decay problems. There is evidence of old, non-active beetle damage around one of the coal doors on the east side of the room. It is particularly evident in the apron above the steps. If this wood is ever removed, it should be replaced with CCA pressure preservative treated ("salt treated") lumber.

Some decay damage had occurred in the joists adjacent to the fireplace hearth framing, but it was repaired many years ago. Considerable quantities of water had either moved laterally through the exterior wall or down from the roof. In either case, the damage was discovered, corrected, and the weakened joists strengthened with new supports. There appears to be no further water leakage.

Some of the joists along the trimmer, parallel to the basement stairs, also show signs of decay. This amount of decay suggests the wood became wet sometime in the past, but this source of moisture was also corrected. Similar decay occurs in the joists where they are set on and in the bricks in the southeast corner. However, there does not appear to be any fungal activity or loss of structural integrity at this time.

This structure, as well as others like it, should be inspected once per year for insect (termite, beetle, etc.) damage, as well as new decay. All joist ends where they enter brick walls and piers should be thoroughly inspected for signs of termites and decay. All wood framing exposed in crawl spaces should be inspected as well.

All sources of moisture should be corrected as soon as they occur. These include leaking pipes, roof and wall leakage, and condensation due to a lack of ventilation or differential temperatures. Only one such leak was found during the inspection. The relief valve on the H. B. Smith furnace was leaking. The water was wetting the wood post nearby, which will make the wood wet enough to permit decay and possibly attract beetles. Lines from relief valves and lines for condensation water should be piped all the way to floor drains or to the outside to ensure the discharged water does not contact wood.

Another possible source of water is the HVAC on the second floor. This unit should be checked daily to be certain the drain does not become clogged.

Decay fungi cannot grow unless the wood moisture content is quite high, around 25 percent. At this moisture content, the wood looks and feels wet. Some insects, on the other hand, can live in wood that is quite dry. Therefore, any wood artifacts or secondhand replacement materials used in any reconstruction should always be carefully inspected to be certain they are not infested before they are placed in a structure, even though the wood appears to be dry. This is particularly true for beetles.

Room 202. In the northwest corner of this room there was a decay problem in the floor. The source of water was stopped and, thus, the decay stopped.

Porches 2nd Floor. The exterior woodwork should be closely watched, since there are many places where water can be trapped and wet the wood sufficiently to support decay fungi. This can be included in the annual inspection program.

Carriage House. This building is slightly infested by the old house borer. Evidence can be seen in two 6x6 inch pine posts. One is to the right of the stairway as one proceeds from the ground to the second floor. The second is a 6x6 inch post on the second floor on the south side of the door frame as one enters room 219. The larvae of this beetle can infest extremely dry softwood and frequently occur in these types of structures. Its chewing mouth parts are so large tht it actually causes visible scratches in the wood and can be heard if all is quiet. I do not recommend treatment at this time, but the dust should be vacuumed and the damage should be checked in the annual inspection. The beam over these posts appears to be affected as well and should also be inspected carefully each year.

Building 114 - E. Leigh Street

This building is in much worse condition than the Maggie Walker house. The crawl space is very poorly ventilated and should be inspected thoroughly every year. All cellulose debris like cardboard and wood scraps should be removed from the crawl space, since they can be attractive to termites that can then move into the structure.

There is termite damage in the joists of the rear room of the first floor. I am uncertain how active or inactive the colony is, since the low temperatures we witnessed would reduce their exposure. Some of the joists will have to be replaced. I recommend that CCA pressure preservative treated lumber be used for all replacements. This material will not stop termites from entering the building or infesting untreated wood portions of it. They can build mud tunnels over the CCA material, but they will not infest it. Since the damage is rather extensive, treatment of the soil along the foundation and of the masonry at the ends of the joists should be considered. Care must be exercised in selecting the proper chemical and a certified, competent applicator.

Since the joists were placed as the walls were built, replacements may have to be installed in two pieces to take advantage of the wall notches. If so, a girder would have to be used to support them in the middle. Placement of a girder would limit access by reducing the crawl space, and it might be advisable to remove some dirt now before new materials are placed; provided that the proper steps were taken to protect the site and any artifacts that might be in the dirt.

On the second floor, there appears to be a leak in the roof over the men's restroom. The entire roof should be inspected.

On the front exterior, the entablature has been damaged by water. This, too, may be due to leaks in the roof.

The front door sill shows considerable effects from the weather. It also appears that the support below the sill has decayed. All of this may have occurred after the concrete stoop was poured. Concrete against a building is a poor practice, if there is wood in the wall below the level of the top of the concrete. Moisture has probably been trapped between the stoop and the wall and migrated into the floor framing. This is also an excellent entrance point for termites. In any subsequent restoration of the exterior, I would recommend the removal of this concrete.

Building 112

The porch of this house (now occupied) should be inspected for termites from below due to its proximity to the concrete stoop of building 114. The porch roof of building 112 should also be inspected for leaks, because the paint on the porch ceiling appears to be water damaged.

All of the occupied portion of building 112 should be checked closely for termites because of the infestation in the rear of 114 where they adjoin. Building 112 is in a high risk situation and should be considered for soil and masonry treatment as well.

Fort Harrison

Two buildings at Fort Harrison were examined. They were the old maintenance building and log house 205.

Old Maintenance Building. The old maintenance building has a number of insect problems. The most serious is a termite infestation, visible in several locations, along the partitions that divide the entire building into three large, open-bay sections. There is one infestation about the center of the west wall of the central 6-bay area. In addition, there are at least three locations where termites have been active on the east wall of the central bay area. In both of these cases, I suspect that the wood partitions were built over some kind of joint in the concrete floor and that the termites are moving up through it. Termite shield is visible under the plate at a depression in the floor, which suggests the floors of the two west bay areas are joined under the wall. In the 2-bay area on the east end of the building, termites were reported near the northeast corner in May 1983. I did not observe this particular spot.

The termite infestation is probably active, although we did not observe any of the insects. This could have been due to the low temperatures or to a previous discovery and treatment. If there has been no treatment, then the slab floor should be drilled and the proper insecticide applied to the soil under it. Any such application should be carried out by a certified applicator. At a minimum, the floor under the interior partitions, as well as the perimeter of the floor should be treated. This does not preclude the possibility that the termites will tunnel under the treated soil at the perimeter, move into structural cracks in the floor, and follow them back to wood framing or wood objects stored in the building; but it would be a first and minimum step toward control.

This building has what was intended a metal termite shield or vapor barrier under the bottom plates. As old as this building is, I suspect that deterioration of the metal, improper placement, or inadequate overlap have by now permitted termites to penetrate it.

There is also a number of places where wood destroying beetles have caused damage. Anobiid beetles have attacked in the east wall and southeast corner of the central bay area at the top plate, and in the northeast corner. The large work table along the north wall, near the west end of the central bay area, is also infested with anobiid beetles.

Another beetle, old house borer, is also active in the southwest corner of the central bay area, in the western-most 2-bay area behind the sign racks, and in the southeast corner of the central bay area at the top plate.

The old house borer is frequently present in pine wood in older buildings like this one and the Carriage House at Maggie Walker's. Unless timbers become unsound to the point of crushing, and unless the building is an historic structure, it is usually uneconomical to treat. The larvae of these beetles can attack extremely dry wood, and even though those present are killed, others can immediately reinfest fumigated wood. Topical treatments are not successful, because they do not penetrate deep enough to kill the larvae already present. In addition, the surface cannot be covered well enough to prevent new attacks in cracks and crevices, and behind other framing members.

Several things can be done now, however, to reduce the risk of more severe attack. All movable, infested objects now in the building should be removed. This includes the table in the central bay area, gun carriages, etc. No infested wood should be permitted in this building. The roof should be kept in good repair, and the drainage behind the building should be improved to prevent roof runoff from collecting around the foundation. In addition, objects should not be stored against the walls in corners since ventilation and air circulation are necessary and are normally poor in corners. Air vents could also be installed in the north, east, and west walls near the top plate to improve cross-ventilation. This would be particularly important in the corners.

Finally, if it becomes necessary to control the beetles, the building can be fumigated. However, I do not believe the infestations are serious enough to warrant fumigation at this time.

Log Cabin 205. This structure has been heavily infested by a number of wood boring insects, probably since it was built. Currently, it is most seriously infested by anobiid beetles and old house borer. These two beetles, as mentioned earlier, are difficult to control in the first place, but are nearly impossible to control with topical treatments. Since the building is not heated, and since these beetles can have life cycles from 2 to 10 years, I feel that the only practical control is to fumigate now, followed with fumigations about every 10 years. It will have to be refumigated on this type of schedule, since fumigants impart no residual protection.

Topical treatments will not work in my opinion, because not all of the surfaces can be treated. Too many untreated surfaces, like the log end - window jamb interfaces and crevices under chinking, would be accessible to ovipositing females.

If fumigation is chosen to control the beetles, several safety precautions and standards for effectiveness must be followed. They are:

1. A competent, certified applicator should be awarded the contract.

2. A rope barrier displaying warning signs should be erected beyond the perimeter of the building during fumigation.

3. A guard should be assigned to the perimeter of the barrier throughout the fumigation period.

4. Fumscopes and fans should be installed to ensure adequate concentrations and distribution of the gas.

5. The ground under the perimeter of the tarp should be free of leaf litter to help ensure a better seal between tarp and ground.

6. The tarp should be sealed completely and left in place for the prescribed time period--usually 24 hours.

7. If dirt or sand snakes are to be used to help seal the perimeter of the tarp to the ground, indicate in the contract who will supply the material and where it will be obtained. In some cases, contractors plan to turn soil over the tarp from the site immediately beneath the tarp, destroying tree roots and artifacts buried on the site.

Watt House

There is some old, inactive beetle damage on the overhead, exposed beams in the dining room. Likewise, there is no current activity in the beams in the furnace room where old beetle holes are also present. The lower level, particularly the furnace room, should be checked annually for termites because it is partially below grade and because heat from the furnace would make the room more vulnerable. This area should be very carefully checked between occupants, when many of the furnishings would be out of the way. In addition, coverings on the ceiling and walls of the furnace room should be loosened during inspections and areas behind them checked.

There is some decay in the style of the strike side of the north entrance door on the second level. It is not serious, but indicates constant wetting; probably from rainsplash off of the stoop.

The attic was not examined. However, it should be checked at least every two years for roof leaks.

The outside of this house needs to be kept tight. With the considerable exposure of this building, every effort should be made to keep water out of the siding and from entering around windows.

The posts for the stoop on the north side are decaying rapidly. These were apparently set without a moisture barrier. Under these conditions, they are an excellent source of termites. When they are replaced, CCA ("salt") treated timbers should be used. The posts of the south stoop were set on metal shields that provide a barrier to termites that might attempt to enter unseen from the concrete footing under the post. This shield also provides a barrier to moisture entering the post from the concrete.

During the annual inspections, the chimney/wall interfaces at the rake and the dormer cheek walls should be carefully inspected. These are often the points where water enters. In the case of this house, this has apparently not been a problem in the past.

Cartwright House

This house is in excellent condition also, considering its age and weathering of the south wall. There is some old termite damage over the furnace that has weakened at least one joist. Because of the termites and the depth of the notch in the joist, a split has developed that has weakened it further. It does not appear to have failed completely, but a support could be added to the side of the joist and independently supported by posts to ensure against a possible drop in the floor.

There is some old beetle damage in some of the joists under the first floor, as seen from the basement. However, the insects do not appear to be active at this time.

There appears to be water accumulating in the north wall, since the plaster is failing under a window in the north wall of the dining room. All potential sources for the water should be investigated and the leaks stopped. I suggest that windows on the first and second floor be checked for leaks.

Any reconstruction of windows should include installation of flashing. All other potential entry points for water should also be blocked. This includes cracks in masonry, like the mortar bond failures in the brickwork over one window on the north side of the house.

Any reconstruction of piers or basement walls should include the placement of termite shields. Termites can go around the edge of such shields, but at least they are forced into the open where their activity can be observed.

HAZARD TREE ANALYSIS

While there, I examined a number of high use recreation areas for hazardous trees. The following is a report by area.

Fort Harrison

Visitor Center. A pine tree near the VC had failed during a wind storm because the stem was partially decayed. This type of hazard can be difficult to detect at a distance, since the needles are usually a healthy green color and the bark is in place on the stem. The clue to the decay is the high number of exit holes present in the bark, caused when mature sawyer beetles left the tree. The large number of holes indicates that the tree was heavily infested and was probably infested for some time. There may have been some physical weakening caused by the beetles themselves, but the failure was due largely to fungal decay which became established with the beetles.

This is one type of hazard that the park will need to inspect for. Any tree with sawyer damage this extensive should be felled. Trees that are judged hazardous should be felled, if they are within 1 and 1/2 times their height of a high use area like a trail, road, parking area, or picnic table.

In any high use area, dead limbs should be removed from overhead. This also includes trails, picnic areas, etc.

The hardwoods at Fort Harrison are generally young and small, and will become the next forest. As can be readily observed, the pines are declining and dying. At the current rate, most of the mature pines will be gone from the area within a few years. As they die, they should be felled for a distance of 1 and 1/2 times their height from use areas.

Some hardwoods should not be permitted to attain a large size. They include those of questionable anchorage, like the ones in the earthworks rooted at or above the water line in the ditch between areas 203 and 209. Chuck and I discussed several, particularly some that are leaning over the ditch toward the road. The larger these trees become, the more leverage there is on the roots, which are anchored in wet soil. In addition, the earthworks comprise disturbed soil which has settled over the last 100 years but which may not be completely stable.

One other point that should be made here and will be mentioned again is the damage large trees can cause to the earthworks themselves. When they become large and are windthrown, dirt will be pulled up with roots, and erosion may follow. In addition, softening and erosion may continue as roots that are left behind decay, leaving channels for water to penetrate. Decaying stumps and roots of trees that are cut will also allow water to penetrate. Therefore, the only alternative is to cut the trees when they are small or otherwise prevent their growth beyond the sapling stage.

White's Battery. There are a number of dead pines that should be felled if they are within 1 and 1/2 times their height of the road. There is a post oak suffering from a stem disease called Strumella canker that is located in Ben Sheler's front yard that should be felled. A disease of pines caused by the fungus Fomes annosus is affecting trees in the front yard of the Zehler residence. One was marked for felling that has a particularly thin crown which indicates a poor root system.

Fort Harrison (Fort Proper). A large sweetgum in the earthworks directly behind the Ft. Harrison/Ft. Burnham sign should be felled. It is quite large and has a full, heavy crown. When it is in full foliage and is exposed to high wind, there is a possibility of failure. Considering it is growing in the earthworks, I feel that it is too large for its anchorage.

Several of the pines inside the fort near the cannon look weak and need to be closely watched for continued decline. Their smooth bark suggests they are mature to overmature. In addition, the smooth knobs on the main stems suggest they are infected with the heart rot fungus Fomes pini. Since they have weak crowns and symptoms of heart rot, I would consider them for removal in the next 3 to 5 years.

Area 205 (Log Cabin). All of the pines in this area, like most in Fort Harrison, are old, weak, and in poor condition. Thirteen pines are dead and should be cut. Five are on the east side of the service road. The remainder are near the cabin or the lawn surrounding it. One green-topped tree, located on the west of the road near the power line and directly opposite the pole and transformer, is cankered from infection by the fusiform rust fungus and should be removed.

Area 204 (Picnic Area). This area is similar to the other pine areas of Fort Harrison. There are two dead trees at the service road gate where the hard surface ends and several dead pines at the north end of the picnic area that should be felled. In addition, all dead pines around the perimeter that are within 1 and 1/2 times their height to the picnic area itself should be felled.

The stems of the larger, older pines also have a lumpy appearance due to heart rot. These should be watched closely for signs of failure.

One additional tree that should be removed now is the forked tree with a steep V fork that is located right beside the signs at the picnic area. This tree is wedging itself apart at the fork because both limbs are growing against each other. It will fail during high wind, heavy snow, or ice.

All dead pines within the prescribed perimeter should be cut as soon as possible. This is true of any other tree identified as a hazard, because once a tree is identified as a hazard, it is so from that point onward.

Chickahominy Bluffs. The pines in the main visitor area, near the parking lot, are Virginia pine and are undesirable in high use areas. This species is shallow rooted and is not windfirm. In addition, the root rot fungus Fomes annosus was found growing on the stump of a recently cut tree. Trees not targeted for immediate removal (two were marked in December) should be watched closely for any signs of failure, particularly root failure. Such a failure would be indicated if the tree begins to lean and the roots begin to pull up on one side.

Virginia pine in this and other high use areas should be targeted for removal over the next 5 to 10 years. It does not tolerate wind stress very well and is frequently uprooted or breaks off at the main stem. If removing the Virginia pines from a high use area will denude it, other trees, particularly hardwoods, can be planted.

The two pines that were marked suffered sawyer damage and have thin crowns. Several more were marked along the trail.

Beaver Dam Creek. Along the road and at the overlook there is a number of trees that are dead, dying, or structurally unsound that should be felled as soon as possible. Considering the size of this facility, it has one of the highest concentrations of removals per unit of area of any we examined.

There is a dead tree on the west side of the entrance road. Further in from the entrance there is a yellow poplar with a hollow base that should be felled. When this tree or any hollow tree like it is felled, those doing the cutting should be warned of the hazards involved in cutting decayed or hollow trees.

All dead limbs over the road to this facility should be removed. Trees with limbs that should be removed were marked with a single vertical strip of flagging.

At the end of the road, near the parking area, two live trees (a pine and a gum) were marked because they are leaning and overbalanced. They are also growing on a slight embankment and in the case of the gum, decayed at the base. From their current locations, they could affect traffic and visitors on the entrance road and at the interpretative overlook.

Between the overlook and the creek there are seven dead trees that should be felled. Five are pines and two are hardwoods. All are closer than 1 and 1/2 times their height to a vehicle and pedestrian area.

Watt House (Lawn and Trail). There is a number of catalpa trees in the lawn adjacent to the house. This species of tree is frequently decayed, as these are. However, in your case, the trees are small and pose less of a safety hazard than most. These trees are also probably historic themselves, and so every attempt should be made to protect them now and to maintain catalpa at this site.

To minimize the rate of deterioration, the trees should be kept pruned, and stresses on them should be reduced. This can be done by placing props under limbs that are within 6 feet of the ground. For higher limbs, cables can be used to tie weak ones to the tree. Cables should run from a main stem to a limb below, with angles no less than 45 degrees to the stem. They can also run from limb to limb only if the limbs are opposite and of approximately the same size. The cables should not be wrapped around the limb or stem, but should be attached to a lag bolt screwed into the wood. If the limb is hollow or too decayed to hold a lag bolt, a standard eye bolt should be installed and held with a large washer and nut.

Another option that you should consider is replacement of these trees. That can be done by growing seedlings from seed or from cuttings taken from basal and stem sprouts. If you can root cuttings from these trees, you will have continued the exact same genetic material and thus preserved the historic fabric itself.

A black locust tree in the lawn was marked for removal. This tree is typical of this species. It contains a great deal of dead wood in the top, is infected with the decay causing fungus Fomes rimosus, and will break up at an early age. This is a very poor species to keep in any area where pedestrians, vehicles, buildings, or desirable trees might be damaged if they fail. Near this tree, there is a rather nice oak that should also be protected from the locust. It is a much better quality shade tree and will be much safer and more attractive in the long run.

Watt House Trail. Near the beginning of the trail, a gum was marked for felling. It is cankered and is weak and subject to breakage at the canker. Further along we marked a red maple that had split and was infected with a decay fungus.

A number of dead pines, a dead oak, and an oak with a dead limb over the trail were marked. They are located on the slope just prior to the first drainage.

There are two extremely large oak trees to the left of the trail just past the first drainage, but prior to the breakthrough point. These two trees are quite large and their loss will cause a serious change in aesthetic quality. Before they become hazardous, and before foot traffic on the trail causes any impact on the roots, I recommend that the trail be relocated further away from the trees to a line west of its present location. The trees would still be visible, yet the risk to hikers would be reduced to an acceptable level, while protecting the trees from soil compaction and subsequent root damage.

Cold Harbor. The pines at Cold Harbor are deteriorating and will continue to do so for many years. All dead pines within 1 and 1/2 times their height of any pedestrian or vehicular area should be felled. We marked two yellow poplars (one, a tall stump) that should also be felled.

One pine, along the trail between the Confederate and Union turnouts, is leaning and should be felled. A tree that is leaning in this manner may be suffering from root failure.

The dead pines in the drainage to the right of the road just before exiting the area were examined and found to be suffering from the root disease fungus Fomes annosus. This fungus, which causes root rot, is quite serious when it occurs in a recreation area. Trees that are infected can suffer a dramatic loss of root integrity and fall even though they appear to be healthy. For this reason, I recommend that the following steps be taken:

1. Nothing should be done in the immediate area of the infected trees that would encourage visitor use. For example, no trails, etc., should be planned, since the infection has probably spread to surrounding trees that appear healthy.

2. Remove trees with crowns that appear thin and unhealthy.

3. Do not encourage or even permit the pine understory to mature. These trees will also probably become infected in time.

4. Inspect heavily used areas closely for evidence of annosus root rot. Such areas include trails like the one between the Confederate and Union turnouts. If annosus is found, the trees should be removed. In addition, stump treatment with the competing fungus, Peniophora gigantea, should be undertaken. (If you decide to use this material, contact me for further information about it.)

At Cold Harbor there is some consideration being given to the use of prescribed fire. This is a valuable tool that can be used to control litter accumulation and understory growth. However, it should be noted that fire can cause damage to hardwoods. Most of the basal stem decay and heart rot in hardwoods was caused by wildfires of the past. Since these defects can precipitate hazardous tree conditions, every caution should be exercised when selecting fire or doing the actual burning to protect hardwoods in the burn area that will be kept.

Trees can also have an impact on the cultural resource. As mentioned earlier, trees growing on earthworks can uproot when they become large, causing direct damage as well as depressions that might trap water. As the roots that are left deteriorate, water and rodents can penetrate deeper into the earthworks. Over much of the battlefield, the trees are nearing the end of an average 100+ year rotation. In your case, this means they are reaching a mature size and are reaching the end of their prime years when they are most vigorous. Therefore, it is a good time for the Park to write a definitive management program for trees on earthworks, even to the point of establishing a priority on the order in which different locations will be treated first.

Fort Brady. A prime example of large trees in earthworks occurs at Fort Brady. A number of trees were marked here largely because they were quite large and of questionable anchorage. Two large oaks near the overlook fall into this category. Knowing that total removal of all trees would be very expensive and labor intensive and would augment the growth of weeds and brush, you might consider removal down to a diameter class. For example, trees may be considered for removal when they reach a size of 10 inches d.b.h. Two hardwood trees were also marked near the plaque.

To the rear of a shed located on the Richmond Yacht Club, we marked an 8-inch d.b.h. Virginia pine that should be removed. This tree is at the top of a large bank and with increased size, could fail, setting off a chain reaction with hardwoods below.

Fort Gilmer. At this location, a number of trees were again marked because they are not firmly anchored. Two pines, one Virginia pine with exposed roots and one forked loblolly were marked. They are located near the cannon. As mentioned earlier, Virginia pines are notoriously shallow rooted and prone to failure under ice, snow, and wind loads. For this reason, they should not be permitted to grow beyond the sapling stage.

Three more Virginia pines were marked about midway of the Fort's length. One was forked and one had exposed roots. Nearby, one dead pine, three loblolly pines, and one hardwood at the hook in the road near the end of the Fort were also marked for felling.

Another oak at Battery Alexander, with a badly decayed butt, was marked for felling. My field notes show this near the vacant white house. I cannot picture this tree now, but Dave Shockley, who was with me at the time, may remember.

Fort Darling. The trees growing inside Fort Darling constitute a mature hardwood stand. This complete overstory provides a scenic area and, due to the total canopy, has prevented any significant understory from developing.

Of the problems discussed to date, Fort Darling dramatically demonstrates the problem of large trees growing on earthworks. The soil, even though it has been in place for about 120 years, does constitute disturbed earth. Some of the trees are tall, thus putting considerable strain on their root systems. All of these factors together create trees hazardous to visitors, as well as trees with a considerable potential to damage the earthworks.

A large number of trees were marked because of their declining state, size, and position on the earthworks. One, just beyond the footbridge, is dead and was marked for felling. A live snag near the upper end of the trail and to the left of the trail was also marked.

Upon entering the Fort, two live trees, one to the left behind the fence and one on the right, were marked. Both are oaks. Just at the point where the trail forks, an oak approximately 8 inches d.b.h. was marked on the right. Two more oaks were marked just beyond the Columbiad. They are also on the shoulder of the earthworks. Additional trees that were marked include:

- one live oak west of the well (to right of trail)
- one dead oak beyond well
- one live oak to right of bridge at stop 8
- one live oak between trail and steps at the western corner of the Fort
- one live oak near the first embattlement, growing on shoulder of earthworks
- one live oak back near the point where the trail forks. This tree is at the top of the bank behind the fence where the riverbank is under cutting the Fort.

All of the marked trees constitute an immediate hazard, in my opinion. It is also my opinion that this problem will continue at this location until most of the trees are removed.

From the entrance to the Fort we followed the fence that parallels the river. About nine trees were marked near the service road. Three were located between the fence and bluff. The remainder were to the left of the trail (opposite side of trail from fence).

Fort Darling-River Trail. To the right of the steps, leading uphill from the creek toward the Fort, there is a dead snag that should be cut immediately. In this and similar cases, extreme caution should be exercised during the cutting operation. Snags like this one, or hollow, leaning, or otherwise defective trees are extremely dangerous to cut. It is often difficult to predict the direction and timing of fall because of the influence of the defect. Another snag is located on the left side of the trail at the high point of the trail.

Along the crest of the hill and along the steps leading down to the river, there is a number of trees that show evidence of wildfire damage. As can be readily observed, the fire caused the death of the bark and cambium, and permitted decay fungi to develop in the woody tissue.

I much enjoyed meeting you and working with Chuck and Dave. Your natural and cultural resource management programs alone are quite varied and extensive, and you are fortunate to have such a competent staff.

I have enclosed some literature that you may find useful.

If you have any questions regarding this report or other matters, please feel free to let me know.

Sincerely,

WILLIAM H. SITES
Pathologist

Enclosures

cc: Chuck Ratkind
Carothers
Toko
Alex
Doraville
Sites

WHSites/drt/1/26/94